



US Army Corps  
of Engineers®  
Walla Walla District



**DRAFT**  
**Lower Snake River Juvenile  
Salmon Migration Feasibility Report/  
Environmental Impact Statement**

**APPENDIX S**  
**Snake River Maps**

December 1999

## FEASIBILITY STUDY DOCUMENTATION

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### Document Title

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Summary to the Lower Snake River Juvenile Salmon Migration Feasibility  
Report/Environmental Impact Statement

Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact  
Statement

Appendix A	Anadromous Fish
Appendix B	Resident Fish
Appendix C	Water Quality
Appendix D	Natural River Drawdown Engineering
Appendix E	Existing Systems and Major System Improvements Engineering
Appendix F	Hydrology/Hydraulics and Sedimentation
Appendix G	Hydroregulations
Appendix H	Fluvial Geomorphology
Appendix I	Economics
Appendix J	Plan Formulation
Appendix K	Real Estate
Appendix L	Lower Snake River Mitigation History and Status
Appendix M	Fish and Wildlife Coordination Act Report
Appendix N	Cultural Resources
Appendix O	Public Outreach Program
Appendix P	Air Quality
Appendix Q	Tribal Consultation/Coordination
Appendix R	Historical Perspectives
Appendix S	Snake River Maps
Appendix T	Biological Assessment
Appendix U	Clean Water Act, Section 404(b)(1) Evaluation

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The documents listed above, as well as supporting technical reports and other study information, are available on our website at [www.nww.usace.army.mil](http://www.nww.usace.army.mil). Copies of these documents are also available for public review at various city, county, and regional libraries.

## **FOREWORD**

This appendix is one part of the overall effort of the U.S. Army Corps of Engineers (Corps) to prepare the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (FR/EIS).

Please note that this document is a DRAFT appendix and is subject to change and/or revision based on information received through comments, hearings, workshops, etc. After the comment period ends and hearings conclude a Final FR/EIS with Appendices is planned.

The Corps has reached out to regional stakeholders (Federal agencies, tribes, states, local governmental entities, organizations, and individuals) during the development of the FR/EIS and appendices. This effort resulted in many of these regional stakeholders providing input, comments, and even drafting work products or portions of these documents. This regional input provided the Corps with an insight and perspective not found in previous processes. A great deal of this information was subsequently included in the Draft FR/EIS and Appendices, therefore, not all the opinions and/or findings herein may reflect the official policy or position of the Corps.

# **STUDY OVERVIEW**

## **Purpose and Need**

Between 1991 and 1997, due to declines in abundance, the National Marine Fisheries Service (NMFS) made the following listings of Snake River salmon or steelhead under the Endangered Species Act (ESA) as amended:

- sockeye salmon (listed as endangered in 1991)
- spring/summer chinook salmon (listed as threatened in 1992)
- fall chinook salmon (listed as threatened in 1992)
- steelhead (listed as threatened in 1997)

In 1995, NMFS issued a Biological Opinion on operations of the Federal Columbia River Power System. The Biological Opinion established measures to halt and reverse the declines of these listed species. This created the need to evaluate the feasibility, design, and engineering work for these measures.

The U.S. Army Corps of Engineers (Corps) implemented a study after NMFS's Biological Opinion in 1995 of alternatives associated with lower Snake River dams and reservoirs. This study was named the Lower Snake River Juvenile Salmon Migration Feasibility Study (Feasibility Study). The specific purpose and need of the Feasibility Study is to evaluate and screen structural alternatives that may increase survival of juvenile anadromous fish through the Lower Snake River Project (which includes the four lowermost dams operated by the Corps on the Snake River—Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams) and assist in their recovery.

## **Development of Alternatives**

The Corps completed an interim report on the Feasibility Study in December 1996. The report evaluated the feasibility of drawdown to natural river levels, spillway crest, and other improvements to existing fish passage facilities. Based in part on a screening of actions conducted in the interim report, the study now focuses on four courses of action:

- Existing conditions (currently planned fish programs)
- System improvements with maximum collection and transport of juveniles (without major system improvements such as surface bypass collectors)
- System improvements with maximum collection and transport of juveniles (with major system improvements such as surface bypass collectors)
- Dam breaching or permanent drawdown to natural river levels for all reservoirs

The results of these evaluations are presented in the combined Feasibility Report (FR) and Environmental Impact Statement (EIS). The FR/EIS provides the support for recommendations that will be made regarding decisions on future actions on the Lower Snake River Project for passage of juvenile salmonids. This appendix is a part of the FR/EIS.



## Geographic Scope

The geographic area covered by the FR/EIS generally encompasses the 140-mile long lower Snake River reach between Lewiston, Idaho and the Tri-Cities in Washington. The study area does slightly vary by resource area in the FR/EIS because the affected resources have widely varying spatial characteristics throughout the lower Snake River system. For example, socioeconomic effects of a permanent drawdown could be felt throughout the whole Columbia River Basin region with the most effects taking place in the counties of southwest Washington. In contrast, effects on vegetation along the reservoirs would be confined to much smaller areas.

## Identification of Alternatives

Since 1995, numerous alternatives have been identified and evaluated. Over time, the alternatives have been assigned numbers and letters that serve as unique identifiers. However, different study groups have sometimes used slightly different numbering or lettering schemes and this has led to some confusion when viewing all the work products prepared during this long period. The primary alternatives that are carried forward in the FR/EIS currently involve four major alternatives that were derived out of three major pathways. The four alternatives are:

Alternative Name	PATH <sup>1/</sup> Number	Corps Number	FR/EIS Number
Existing Conditions	A-1	A-1	1
Maximum Transport of Juvenile Salmon	A-2	A-2a	2
Major System Improvements	A-2'	A-2c	3
Dam Breaching	A-3	A-3a	4

<sup>1/</sup> Plan for Analyzing and Testing Hypotheses

## Summary of Alternatives

The **Existing Conditions Alternative** consists of continuing the fish passage facilities and project operations that were in place or under development at the time this Feasibility Study was initiated. The existing programs and plans underway would continue. Project operations, including all ancillary facilities such as fish hatcheries and Habitat Management Units (HMUs) under the Lower Snake River Fish and Wildlife Compensation Plan (Comp Plan), recreation facilities, power generation, navigation, and irrigation would remain the same unless modified through future actions. Adult and juvenile fish passage facilities would continue to operate.

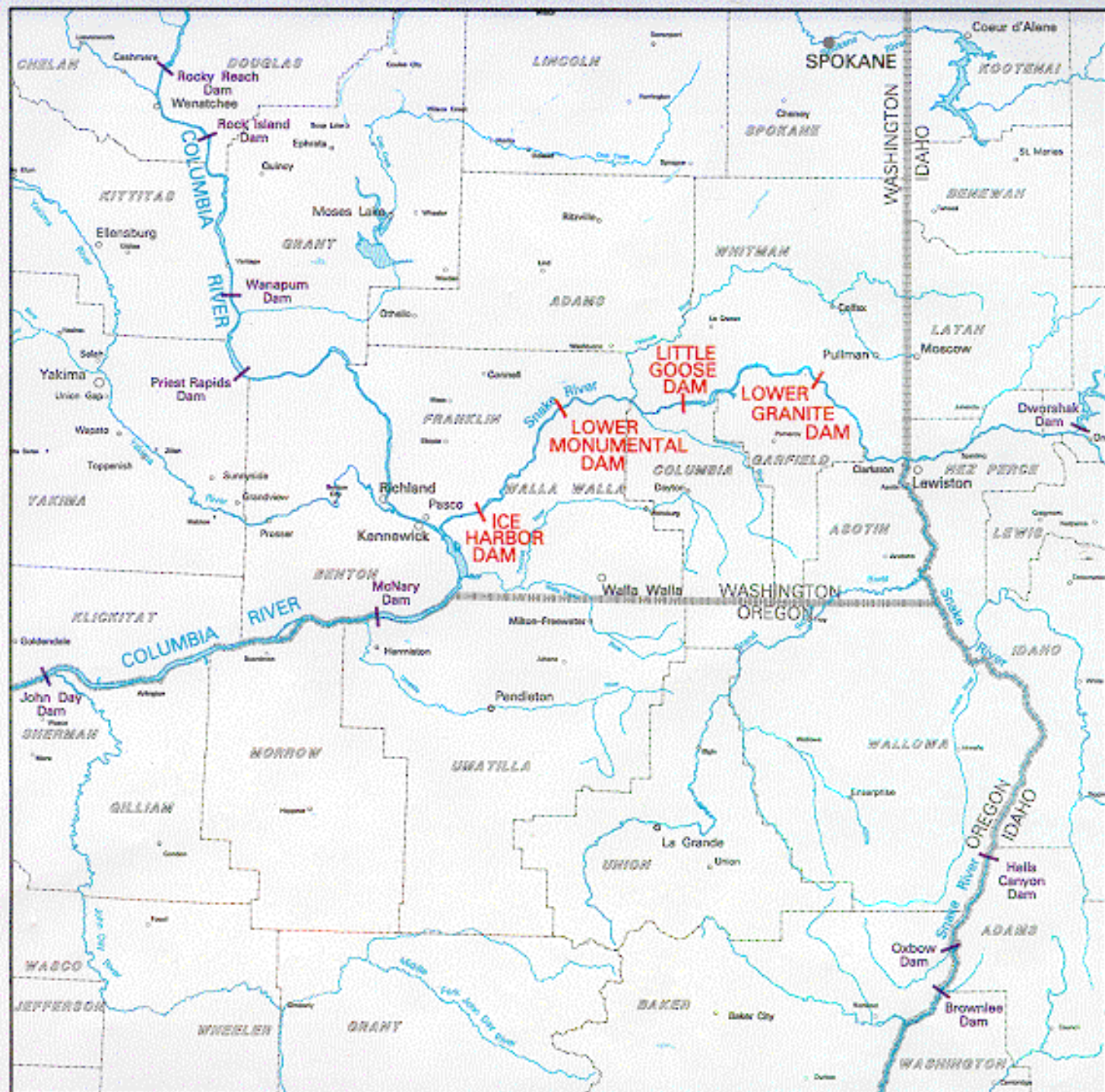
The **Maximum Transport of Juvenile Salmon Alternative** would include all of the existing or planned structural and operational configurations from the Existing Conditions Alternative. However, this alternative assumes that the juvenile fishway systems would be operated to maximize fish transport from Lower Granite, Little Goose, and Lower Monumental and that voluntary spill would not be used to bypass fish through the spillways (except at Ice Harbor). To accommodate this maximization of transport some measures would be taken to upgrade and improve fish handling facilities.

The **Major System Improvements Alternative** would provide additional improvements to what is considered under the Existing Conditions Alternative. These improvements would be focused on using surface bypass collection (SBC) facilities in conjunction with extended submersible bar screens (ESBS) and a behavioral guidance system (BGS). The intent of these facilities is to provide more effective diversion of juvenile fish away from the turbines. Under this alternative the number of fish collected and delivered to upgraded transportation facilities would be maximized at Lower Granite, the most upstream dam, where up to 90 percent of the fish would be collected and transported.

The **Dam Breaching Alternative** has been referred to as the “Drawdown Alternative” in many of the study groups since late 1996 and the resulting FR/EIS reports. These two terms essentially refer to the same set of actions. Because the term drawdown can refer to many types of drawdown, the term dam breaching was created to describe the action behind the alternative. The Dam Breaching Alternative would involve significant structural modifications at the four lower Snake River dams allowing the reservoirs to be drained and resulting in a free-flowing river that would remain unimpounded. Dam breaching would involve removing the earthen embankment sections of the four dams and then developing a channel around the powerhouses, spillways, and navigation locks. With dam breaching, the navigation locks would no longer be operational, and navigation for large commercial vessels would be eliminated. Some recreation facilities would close while others would be modified and new facilities could be built in the future. The operation and maintenance of fish hatcheries and Habitat Management Units (HMUs) would also change although the extent of change would probably be small and is not known at this time. Project development, design, and construction span a period of nine years. The first three to four years concentrate on the engineering and design processes. The embankments of the four dams are breached during two construction seasons at year 4-5 in the process. Construction work dealing with mitigation and restoration of various facilities adjacent to the reservoirs follows dam breaching for three to four years.

### **Authority**

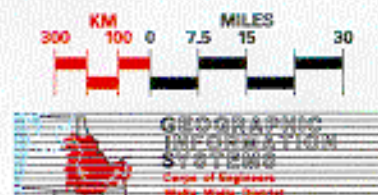
The four Corps dams of the lower Snake River were constructed and are operated and maintained under laws that may be grouped into three categories: 1) laws initially authorizing construction of the project, 2) laws specific to the project passed subsequent to construction, and 3) laws that generally apply to all Corps reservoirs.



**BOUNDARIES**

State

County



125,000 ACRES



1 : 1,900,800

**DRAFT**

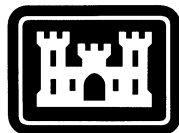
**Lower Snake River**  
Juvenile Salmon Migration Feasibility Study

**REGIONAL  
BASE MAP**

1999

## **ABSTRACT**

This is Appendix S—Snake River Maps to the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement. This appendix was prepared by the U.S. Army Corps of Engineers Walla Walla District. This appendix is intended to share maps and aerial photo displays of the Lower Snake River Project (LSRP). These presentations give the reader insight into the LSRP prior to dam construction (before 1961) and after dam construction (after 1975).



**US Army Corps  
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Walla Walla District

**Draft**

**Lower Snake River Juvenile Salmon  
Migration Feasibility Report/  
Environmental Impact Statement**

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**Appendix S**

**Snake River Maps**

**Produced by**  
**U.S. Army Corps of Engineers**  
**Walla Walla District**

Completed November 1999  
Revised and released for review  
with Draft FR/EIS  
December 1999

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## CONTENTS

1.	Introduction	S1-1
2.	Mapping Products	S2-1
2.1	1934 Survey Drawings	S2-1
2.2	Aerial Photography	S2-2
3.	Map Presentations	S3-1
3.1	Survey Drawing Displays	S3-1
3.2	Pre- and Post-Dam Comparison Displays	S3-1
Annex A	1934 Survey Drawings: Sheet Numbers 1 Through 131 and Overview Sheet	
Annex B	Pre- and Post-Dam Comparison Displays	

## TABLES

<b>Table 2-1.</b>	Aerial Flight Information	S2-3
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## **ACRONYMS AND ABBREVIATIONS**

3-D	three dimensional
dpi	dots per inch
GIS	geographic information system
LSRP	Lower Snake River Project
msl	mean sea level
RM	River Mile
USE	U.S. Engineer



# **1. Introduction**

This appendix is intended to share maps and aerial photo displays of the Lower Snake River Project (LSRP). These presentations give the reader insight into the LSRP prior to dam construction (before 1961) and after dam construction (after 1975).

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## 2. Mapping Products

### 2.1 1934 Survey Drawings

Documented surveys with depth-soundings on the LSRP were first conducted in the late 1800s. Only two depth-sounding surveys cover the entire LSRP and these were completed in 1917 and 1934. The 1934 survey was chosen for this appendix because it contains much more detail. Since 1934, depth-sounding surveys were conducted only on selected areas within the LSRP. The figures in this appendix are from the original linen drawings.

#### 2.1.1 Type of Data

The survey drawings are a collection of 155 sheets covering 176 river miles, beginning at the mouth of the Snake River (River Mile 0.0) and were originally drawn at the scale of 1:2,000.

The 1934 drawings include the following information:

- topographic contours (5 foot)
- shoreline
- ground descriptions (grass, sand, cultivated)
- sounding depths
- depth contours (6 and 9 foot)
- proposed navigation channel centerline
- northing/easting and longitude/latitude tick marks
- U.S. Engineer (U.S.E.) bench marks
- river miles (not the same as reservoir river miles)
- roads and railroads
- substrate information
- islands
- low water elevation marks
- buildings
- rapids (average & maximum velocity)
- spot elevations
- monument stations

#### 2.1.2 Original Purpose

The drawings are taken from a larger report entitled *Review Report, Snake River, Washington-Idaho, Mouth to Oregon-Washington Line*, dated June 10, 1935, by the U.S. Engineer Office, Portland, Oregon. Sounding data was taken to determine a proposed navigation channel, document the topography, and site locations of rapids.

#### 2.1.3 Survey Components

The method of survey is not known because the associated report or other documentation was not found with the drawings. The original maps were prepared on linen media. Notes on the drawings identify the following creation specifics:

- Elevations are referred to as mean sea level (msl) (U.S.C & G.S. Datum 1929 adjustment).
- Soundings are in feet and tenths and show depths at adopted low water plane (based on 0.0 at U.S. Weather Bureau gage at Riparia, El 512.05 msl).
- Figures in parentheses indicate height in feet above low water (for example, 1.7).
- Contour interval is 5 feet.
- Distance in miles from mouth of river is measured on the centerline of the proposed channel.

### **2.1.4 Electronic Conversions and Processing**

In 1998 the Walla Walla District converted the 1934 drawings to 3-D geographic information system (GIS) files. At the same time the approximately 126,000 sounding points (depth of river) were also converted into 3-D GIS files with horizontal and vertical values. The drawings were scanned at 200 dots per inch (dpi). Longitude and latitude tick mark information was taken from the drawings, inputted into files, and labeled. During data verification of the longitude and latitude tick mark locations, the tick marks were found not to match current coordinate systems, so drawings do not correctly overlay current topographic data. Images were geographically referenced into position using the longitude and latitude locations from the drawings. The raster line work was then converted into 3-D vector data with each reservoir reach as the upper and lower boundary for that section of the river.

## **2.2 Aerial Photography**

### **2.2.1 1956 to 1962**

Aerial photography flown between 1956 and 1962 was stereoplotted to develop topographic mapping. The topographic mapping was used to geographically reference the 1958 aerial photography that represents the pre-project condition for the LSRP. See Table 2.1 for aerial flight details.

### **2.2.2 1958, 1991, and 1992**

Aerial photography was flown in 1958, 1991, and 1992 for the purpose of recording what the river looked like during that time period. The 1958 aerial flight documents the appearance of the lower Snake River prior to dam construction. The 1991 and 1992 flights provide information used in managing recreation areas and wildlife habitat units within the boundaries of the LSRP. See Table 2.1 for aerial flight details.

**Table 2-1.** Aerial Flight Information

Description	Roll Number	Date Flown	Scale	% Overlap	Control
<b>1956 Snake River</b>					
Snake River Mouth to Riparia	W56-52V	14 Sep	1:20,700	60	Yes
<b>1957 Snake River</b>					
Lake Herbert G. West	W57-70V	10 Sep	1:9,600	60	Yes
Lake Herbert G. West	W57-71V	12 Oct	1:9,600	60	Yes
<b>1958 Snake River</b>					
Low Water — RM 10 to Johnson Bar	W58-74V	28 Aug	1:10,000	Minimum	No
Low Water — RM 10 to Johnson Bar	W58-75V	28 Aug	1:10,000	Minimum	No
<b>1959 Snake River</b>					
Lake Bryan	W59-93V	2 Nov	1:9,600	60	Yes
Lake Bryan	W59-94V	6 Nov	1:9,600	60	Yes
Lake Bryan	W59-95V	14 Nov	1:20,000	60	Yes
Lake Bryan	W59-95V	30 Nov	1:20,000	60	Yes
<b>1960 Snake River</b>					
Lower Granite Lake—Low Altitude	W60-8	1 Dec	1:9,600	60	Yes
Lower Granite Lake—Low Altitude	W60-9	13 Dec	1:9,600	60	Yes
<b>1991 Snake River</b>					
RM 0.0 to Lower Monumental Dam	W91-03	30 Aug	1:24,000	60	Yes
<b>1992 Snake River</b>					
Lower Monumental Dam to Asotin	W92-12	19 Apr	1:24,000	60	Yes

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## **3. Map Presentations**

### **3.1 Survey Drawing Displays**

The 1934 mapping found in Annex A is a subset of the entire mapping collection. Only 131 sheets were selected to represent the LSRP, starting at the mouth of the Snake River to a point above Asotin, WA. An index map in the front of the collection helps the reader select sheets of interest.

### **3.2 Pre- and Post-Dam Comparison Displays**

A total of 22 pre- and post-dam comparison displays have been compiled and are found in Annex B. Each display is of a particular geographic location on the lower Snake River. Aerial photography from 1958, 1991, and 1992 are compared showing pre- and post-dam shorelines along with post-dam shoreline superimposed on the 1958 photo. In addition, up to three oblique photos, taken between 1958 and 1960, are presented with a relationship to the 1958 aerial photo. For those locations where fewer than 3 photos are available, there is a blank area on the sheet. There are 6 displays from the river and reservoir between Ice Harbor and Lower Monumental Dams, 7 displays between Lower Monumental and Little Goose Dams, 8 displays between Little Goose and Lower Granite Dams, and one display from Lower Granite Dam to Clarkston.